### Exercise 1. Decode the term or phrase on the slide:

**Code A:**

```
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
```

**Code B:**

```
a b c d e f g h i j k l m n o p q r s t u v w x y z
```

---

### Exercise 2. Convert the decimal value to binary:

- In decimal, because each placeholder has a value that is ten times that of the one to its right, adding a 0 to the end of a number multiplies the number by 10.

```
1 3 5
```

- In binary, each placeholder has a value that is double that of the one to its right – what should happen when a 0 is added to the end of a binary number?

```
1 0 1 0 0 0 1
```

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### Exercise 3. Decode and draw this Ziv-Lempel compressed binary image:

- For this exercise, consider nibble sized chunks (4 bits).
- The code is the first row of the binary image, as it is represented in binary (0s for white, and 1s for coloured squares), followed by either: a) a memory location in the first row from which 4 bits are read, or b) a binary digit, if there is a pattern of 0s and 1s which cannot be found in the first row.

Row 1: 0011000011110000000
Row 2: H1AKE000
Row 3: J1HCQ000
Row 4: JJLND
Row 5: JJJJC
Row 6: JJJJK
Row 7: JJEQH
Row 8: H1HPE000
Row 9: AALPQ
Exercise 4. Compress an image using Ziv-Lempel coding:

Find the most efficient way to code the butterfly image below – using the least number of letters, 0s, and 1s. You can choose your chunk size, and whether to use rows or columns – YOU DO NOT NEED TO DO BOTH.

- In many cases, a larger chunk size saves memory on some lines, but other lines may present no repeated patterns of a large chunk size.
- For this exercise, each 0 or 1 is stored in one bit, and each memory location is stored in one bit.
- With no compression, a device needs 144 bits to store this image (12 x 12 x 1 bit each)

What approach (rows / columns) and chunk size did your group use?

How many bits does your approach require (in total, including the first row)?

Bonus Exercise: Decode and draw this Ziv Lempel compressed binary image:

- Follow the same instructions as Exercise 3 (chunk size of 4)

If you were to create a font, where each letter of the alphabet had to fit in the same size grid, what size grid would you choose? What is the smallest grid that can be used to adequately represent each letter of the alphabet? Does it have to be square?